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Authors
Duffy, J
Hopkins, E
Kornienko, T
et al.

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Information Choice in a Social Learning Experiment*

John Duffy — UC Irvine

Ed Hopkins — University of Edinburgh

Tatiana Kornienko† — University of Edinburgh

Mingye Ma — NYU Abu Dhabi

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Abstract

This paper reports on a social learning experiment that examines whether there is bias in information acquisition. In contrast to the standard sequential social learning experimental design of Anderson and Holt (1997) where subjects are given both private and social information prior to guessing an unknown binary state of the world, in our experiment, subjects must instead *choose* between receiving a private signal or seeing the guesses made by previous subjects in the sequence (i.e., social information) before forming their own guess. By requiring subjects to make this information choice at different points in the sequence, our within-subject design allows us to separate biased from optimal information choices. Overall, we find that once the number of previous guesses is 2 or greater, the majority of subjects exhibit a bias in favor of choosing social rather than private information. However, there is considerable heterogeneity, with a substantial minority behaving according to a refined equilibrium prediction as well as some subjects consistently choosing social information and others consistently choosing private information.

Keywords: social learning, information, experiments, conformity, social influence.
JEL codes: C72, C92, D83.

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†Corresponding author, e-mail: tatiana.kornienko@ed.ac.uk.

1 Introduction

People often learn by observing others. While such behavior might be interpreted as evidence of conformism, the insight from a large theoretical literature in economics beginning with Bikhchandani et al. (1992) and Banerjee (1992) is that apparent herd behavior can be a rational response to the information contained in the actions of others. One unexplored alternative explanation is that imitative, herd behavior might reflect an individual bias for social information. This paper seeks to differentiate between these two possible explanations.

Laboratory evidence on social learning was first provided by Anderson and Holt (1997), and their design has become a baseline model for later researchers (see Anderson and Holt (2008) for a survey). Following the lead of Bikhchandani et al. (1992) and Banerjee (1992), this social learning literature employs a sequential-move structure, where each subject takes a turn guessing the true state of the world. Prior to making these guesses, each subject observes both an informative private signal and the guesses of the subjects who moved earlier in the sequence. Many replications and modifications to this experimental design have been studied and reported (see for example, Hung and Plott (2001); Celen and Kariv (2004); Goeree et al. (2007); Ziegelmeyer et al. (2010)). Recently, Weizsäcker (2010) combined data from 13 studies containing this base-line experimental design and used a meta-analysis to conclude that people in general tend to overweight their private information and thus underweight social information. In other words, people often fail to learn from others when they should, due to a bias towards using private information.

In this paper, we examine the robustness of this bias toward private information by modifying Anderson and Holt's (1997) design. In our new experimental design, subjects move sequentially (as in Anderson and Holt) but there is an additional stage to each subject's decision. In the first stage, subjects must make a choice between viewing social information (the guesses of other players who moved earlier in the sequence) *or* receiving a noisy but informative private signal. Subjects do *not* get to see both pieces of information, "social" and "private," as in classic social learning theory and the Anderson and Holt design, just the one piece of information they chose to view. In the second stage, after viewing the information they chose to receive, subjects must guess the true state of the world, just as in Anderson and Holt. Furthermore, each subject participates in several different sequences of two different lengths, making decisions in different locations in theses sequences. This design enables identification of individual biases for or against social information as well as evaluation of whether individuals comply with the single piece of information they have chosen to receive.

We use this experimental design to test a theoretical prediction offered by Ma (2018), who shows that in equilibrium private information is chosen by those occupying early positions in the sequence, but social information is chosen by those moving later in the sequence. Intuitively, social information is not valuable until a sufficient number of private signals have been drawn and guesses based on those signals have been recorded. By separating *information choice* from *information use*, our experimental design enables us to directly examine whether subjects choose information *optimally* given their position in the queue, or they instead have a *bias* for or against social or private information.

We find that aggregate behavior approximates the qualitative predictions of this theory in the sense that earlier moving subjects are more likely to choose private information while later moving subjects are more likely to choose social information. However, we find that for a significant majority of subjects, the switch from private to social information comes *too early*. The theory predicts that this switch-over should occur at position four, while in our data it occurs in period three. Importantly, choosing social information at position three is also not *empirically optimal*, as some fraction of subjects in earlier positions fail to comply with the information they receive, which makes social information less accurate than theoretically predicted.

We attribute the premature switch-over to choosing social information to three types of neglect on the part of subjects. The first is "tie neglect", wherein subjects at position three overvalue social information because they do not anticipate that the first two players' guesses could contradict one another. Second, the switch to social information at position three reduces the accuracy of social information at position four; we refer to the failure to correct for duplicates in social information "redundancy neglect" (after Eyster et al. (2015)). Finally, there is a substantial tendency by subjects at *all* positions to guess contrary to the information they chose, which also erodes the value of social information. The failure to adjust for such non-compliance with the information received is a phenomenon we refer to as "non-compliance neglect". Overall, we find that the empirically optimal choice, as opposed to the equilibrium recommendation at position four is to continue to choose private information. Yet, as was the case at position three, a majority of subjects at position four also choose social information. Thus, our results challenge previous findings from imputed information use analysis (Weizsäcker (2010)) that subjects in general overweight private information relative to social information.

Because we obtain precisely the opposite result, it suggests that the bias toward private information in the standard setting may not arise from a persistent cognitive failure, but rather is an artefact of the standard design. There, following social information is typically empirically optimal except at the very start of the sequence, so mistakes are more likely to be in the direction of private information. Here, choosing private information is empirically optimal, so mistakes are towards excessive choice of social information.

In addition to examining subjects' information choices at different positions within a sequence, we explore whether subjects behave differently when making decisions as part of a larger- (4) or smaller-sized (2) group. By comparing the same subjects' behavior when they are in the second position of a "Group" sequence of four subjects, and when placed in the final position of a "Pair" sequence of two subjects, we find that subjects tend to choose private information more often when their decisions can be observed by others later in the sequence (as in the 4-player group).

At the individual level, we identify subjects who always choose private or social information, irrespective of position. Nevertheless, the overall bias we identify is that social information is chosen more often and earlier than it should be, as the empirically optimal strategy here is to always choose private information.

There are several papers related to this one. Kübler and Weizsäcker (2004) modify the Anderson and Holt experimental design by introducing a cost for private signals. In their experiment, social information is freely available by default, but agents have to decide whether to purchase a private signal at a small cost. This design yields the strong prediction that only the first player should buy a private signal. They report that there is excessive purchase of private information. By contrast, Celen and Hyndman (2012) make private information freely available, but subjects must pay to make social links to learn about others' choices. Similarly, they find that subjects buy too much costly social information. Relative to the symmetric design of our paper, in both of these earlier experiments, the two forms of information are treated asymmetrically.

De Filippis et al. (2016) also modify the Anderson and Holt setup but by adding a belief elicitation stage after subjects observe the decisions of others and once again after they have received their own private signal. This design enables them to assess the extent to which subjects update their beliefs, conditional on each type of information received. Their evidence also points to an overweighting of private information, which arises from the asymmetric manner in which agents update beliefs.

Trevino (2017), in a experiment on social learning with a somewhat different design, finds that subjects overweight social information, due to a different form of neglect than those considered here. Subjects respond to the observed actions of others that are not in fact correlated with the state of the world which determines the observer's payoffs.

Goeree and Yariv (2015) designed an experiment aimed at disentangling information-based herding from an intrinsic taste for conformity. In their experiment, before making a decision, subjects face a choice between an informative private signal or the history of actions of predecessors who have not chosen a private signal (word-of-mouth information). In equilibrium, nobody should choose the latter type of social information since it is uninformative. However, Goeree and Yariv (2015) report that approximately one-third of information choices are social, and they conclude that for many people, herding might be a rule of thumb, rationalizing this overweighting of social information.

Importantly, private information is always strictly optimal in Goeree and Yariv (2015), and thus, in their framework, errors can only run in one direction - towards social information. Furthermore, the long sequences of decisions employed in the existing social learning literature, including Weizsäcker (2010), imply that many subjects make decisions in positions where following social information is indeed optimal. Thus, errors again run in only in one direction, but in this case towards private information. By contrast, in our setup, either social or private information can be optimal depending on the situation, which allows for errors in either direction.

The above sequential move games differ from the "balanced" design of Duffy et al. (2018), who also study subjects' choice of social or private information in an experiment where the aim is to guess the true state of the world. However, in their design, subjects do not move sequentially as in the standard social learning experiments. Instead, in Duffy et al., all N players have to individually and *simultaneously* choose whether to use social or private information. The optimal choice depends on the persistence of the state of the world which is subject to change from one period to the next. They find that most subjects choose information rationally, but there exists a sizable and approximately equal fraction of subjects who have a clear bias for social or for private information. We adopt their labels "herd animals" for those with a bias for social information and "lone wolves" for those with a bias for private information. However, in contrast to Duffy et al., subjects in the present experiment choose private or social information *sequentially* and the state of the world they are learning about does not change over time, just as in the standard social learning model.

2 Model and Theoretical Predictions

In this section, we outline the theoretical model and equilibrium predictions that we use as a benchmark of rational play. To do this we use a refinement of equilibrium based on perfection, the idea of taking best responses to small trembles. This section is based on a much more detailed analysis in Ma (2018). Alternative predictions based on persistent mistakes (quantal response equilibrium) and the actual empirical error rate (what is empirically optimal) will be given in Section 4 below.

We assume N players form a sequence and each player has a commonly known and exogenously determined position n in that sequence, {1, 2,..., N}. The parameter $\theta \in \{0, 1\}$ represents the state of the world. Each of the two states has an equal prior probability of 0.5. Players sequentially make a decision (guess) $d_n \in D = \{0, 1\}$ as to what they believe the state of the world to be. The payoff to each player is 1 if $d_n = \theta$, that is, if the guess matches the state, and 0 otherwise. Players seek to maximize their expected utility.

Before making the decision d_n, each player can choose one of the two available pieces of information $i_n \in I(n) = \{s_n, h_n\}$. First, she could receive an independently generated private signal $s_n \in S = \{0, 1\}$. The accuracy of this signal is fixed and commonly known to be q. Specifically, $\Pr(s_n = 0|\theta = 0) = \Pr(s_n = 1|\theta = 1) = q$ and $\Pr(s_n = 0|\theta = 1) = \Pr(s_n = 1|\theta = 0) = 1-q$ for all players. Signals are imperfect but informative because we assume $0.5 < q < 1$. We refer to the choice of receiving a private noisy signal as the choice of "private" information. Second, the player could choose to view a complete history of the decisions made by all predecessors, h_n. Specifically, h_1 is the empty set, $h_2 = \{d_1\}$, $h_3 = \{d_1, d_2\}$, $h_4 = \{d_1, d_2, d_3\}$, and more generally, $h_n \in D^{n-1}$. It should be noted that h_n includes only the *decisions* of others, d_n, and does *not* include the information observed by others, i_k, $k < n$, nor what type of information predecessors have chosen to view. We refer to this second option, to see the history of decisions made thus far in the sequence, h_n, as a choice of "social" information.

Therefore, a player has to solve two problems: first, given her position in a sequence, which information to choose; second, after observing the information she chooses, what guess to make about the state of the world. A strategy for player n is a thus pair of two mappings $m_n = (m^i, m^d)$. The first, m^i, gives a player's choice between private and social information as a function of her position in the sequence. The second, m^d, maps from the information she then sees to a final decision. A strategy profile is a sequence of strategies $m = \{m_1, m_2, ..., m_N\}$.

We use perfect equilibrium (PE), due to Selten (1975), as a solution concept. This is in contrast to the previous literature on social learning which uses (Perfect) Bayesian Nash equilibrium and deals with multiple equilibria by employing tie-breaking rules (see, for example, Banerjee (1992)). PE breaks indifference in favor of private information because the possibility that previous players could have made mistakes lowers the expected accuracy of social information, which relies on the choices of previous players, but does not affect the accuracy of private information. We see this as a reasonable refinement as a positive error rate is inevitable in the actual empirical situation of a laboratory experiment. Consequently, the empirical return to social information will surely be somewhat below its theoretical level, breaking indifference in the direction of private information.[1]

[1]Weizsäcker (2010) thus suggests that the real benchmark for rationality is whether a strategy is

We look for a pure strategy PE. The second decision a player makes, regarding the use of the observed information, is straightforward: players should follow the information that they observe. In the case of the private signal, since it is informative ($q > 0.5$), subjects should follow it. As for social information, since all subjects in a sequence face the same true state and are individually incentivized in the same way, all participants have an incentive to follow their predecessors. Thus the main question is which information to choose to observe in the first place. We find the following.

Proposition 1. *There is a unique PE. In this PE, information choices i_n^* are:*

$$i_n^* = \begin{cases} s_n, & \text{if } n \leq 3 \\ h_n, & \text{if } n \geq 4 \end{cases} \tag{1}$$

In short, the prediction of this equilibrium is that private information should be chosen in positions 2 and 3, but social information should be chosen from position 4 onwards. Note that at position 3 this prediction runs counter to the simple "more is better" heuristic. That rule ignores the possibility that the two previous guesses may "tie" in that players 1 and 2 make opposite guesses. Thus, in fact, social information at position 3 is no more informative than private. But in PE, given even vanishingly small trembles by other players, player 3 must choose private information.

The proof of the above result and details of other equilibria that are eliminated by perfection are given in Ma (2018), but the main argument is as follows. In the absence of trembles, player 2 would be indifferent between private and social information because they both give her access to one informative signal of accuracy q. However, given trembles by other players, first, the accuracy of private information remains constant at q, and, second, there is a positive probability of player 1 not following her signal. Hence, the accuracy of social information for player 2 is necessarily less than the accuracy of the private signal q. Therefore, Player 2's best response is to choose private information and to follow it. Note that this implies that in any PE, player 2 chooses private information and follows it. For player 3 as for player 2, in the absence of trembles, social information is equally informative as private. However, if she places positive probability on player 1 not following her signal, player 2 choosing social information and not following player 1 and player 2 choosing private information but not following the signal, then private information is the best reply for player 3. Thus, player 3 chooses private information (and follows it) in any PE. Finally, the best response for player 4 could be private or social information depending on the exact mix of trembles he faces, but in the limit as the trembles go to zero, his best response must be to choose social information which, because in the PE players 1 to 3 choose private information and follow it, gives access to three independent signals.[2]

"empirically optimal", that is, taking into account the actual error rate in the experiment. In Appendix A, we indeed find that empirically it is optimal to choose private information at those positions where a player would be indifferent in the absence of error.

[2]In contrast, this equilibrium is not the unique trembling hand perfect equilibrium (THPE). This is because a THPE is a perfect equilibrium in the agent normal form, which in this context implies that we separate a player's choice of information from the decision whether to follow the information she subsequently receives. Thus we can support other equilibria as THPE by, for example, choosing a sequence of mixed profiles in which the error rate of player 2 in following private information is higher than the error rate of player 2 when following social information, such that the best response of player 2 to such mixed profiles at the information choice stage to be social information. We do not see this as behaviorally or empirically plausible but we report it for completeness.

3 Experimental Design

The experiment consists of two main parts. At the beginning of the first part subjects were given written instructions that were read aloud so that the rules of the game were public (if not common) knowledge. Then, subjects completed a comprehension quiz to verify their understanding of these instructions, before moving on to making decisions in the first part using networked computer terminals. Once the first part of the experiment was completed, the experiment was paused, and subjects were given written instructions for the second part, which were also read aloud, and were also followed by a comprehension quiz. Then subjects made decisions in the second part.[3]

At the start of each experimental session, all subjects were randomly and anonymously divided into groups of four subjects. Subjects remained in the same group of four subjects for the duration of the session. Then, each subject made decisions in two formations, a $N = 4$-subject "Group" (**G**) formation, and a $N = 2$-subject "Pair" (**P**) formation (involving a further random division of the four subject grouping into two fixed pairs). Apart from the formation size, the decision-making tasks and the environment of the "Group" and the "Pair" formations are identical.

Each session consisted of a number of rounds. At the beginning of each new round, subjects were arranged in a randomly determined sequential order within their formation (i.e., a 4-subject "group" or a 2-subject "pair"). For each formation, subjects were instructed that one of two urns, the "Black" urn or the "Red" urn, would be chosen with equal 0.5 probability and would represent the state of the world for their formation and for duration of that round. Each urn contains three balls. The black urn contains two black balls and one red ball while the red urn contains two red balls and one black ball. Subjects do not know the urn that is chosen (the state of the world for each round), but they do know that each urn is equally likely to have been chosen as well as the number of red and black balls in each urn.

The round then begins with the subject in the first position of the sequence being privately shown a signal of the true state of the world, which amounts to a ball drawn (with replacement) from the urn chosen for the formation (group or pair, henceforth the "formation urn") which by design has accuracy $q = 2/3$. After viewing this signal, this first subject is asked to provide his or her individually incentivized guess as to which urn ("Black" or "Red") was chosen by nature as their formation's urn for that round. Each subsequent subject in a given sequence, prior to making their guess, has to choose to observe either: 1) a private signal in the form of a a new random ball draw (with replacement) from their formation's urn (again, with accuracy of $q = 2/3$); or 2) social information, in the form of the urn color *guesses*, black or red, (and not the signals!) made by all previous subjects in the sequence for their formation for that round. After seeing the information they chose to view (private or social), subjects then submit their individually incentivized guess as to the true state of the world, i.e., the color of their formation's urn (black or red).

After all decisions in a round are made, the color of the formation urn is revealed. Each subject is paid a fixed payment of £5 if her urn guess coincides with their formation's

[3]Instructions used in the experiment are included in the Appendix.

urn in one randomly selected round, and nothing otherwise. As for feedback, at the end of each round, subjects learned the history of the actual urn chosen for the round ("Black" or "Red"), their urn guesses, the type of information they selected, and the content of both the private signal and the social information, the history h_n, (i.e., both the information they chose to see as well as the other piece of information they did not choose to see). This feedback choice was made to allow subjects to learn the value of the two types of information they could choose, private or social, and to dissuade subjects from experimenting out of curiosity. By contrast, subjects never observe the private signals of others nor the information choices made by others during or after any round of the experiment.[4]

Subjects were informed that they would experience each position in the sequence exactly 6 times, but that their position in any particular round would be randomly determined. Thus, they faced 24 rounds of the "Group" formation and 12 rounds of the "Pair" formation. To control for potential "order effects", we conducted two treatment orderings, the "Group-Pair" treatment ordering (**GP**) and the reverse order "Pair-Group" treatment ordering (**PG**). Specifically, in **PG** treatment ordering, in the first part of the experiment, subjects made decisions in the "Pair" formation for 12 rounds followed by making decisions in the "Group" formation in the second part for 24 rounds. In the **GP** treatment ordering, the order of the two parts is reversed.[5]

After these two main parts of the experiment, the experimenter invited two volunteers from the subject participants to roll physical dice to randomly select two rounds from the "Group" part and one round from the "Pair" part for real payment. Thus, each round of the experiment had an equal, 1/12 chance of being selected for payment. In the third part, subjects were offered a fixed payment of £3 for completing a survey that included demographic information, cognitive reflection questions, and further questions designed to identify individual non-cognitive traits (see Appendix D for details). Finally, subjects were invited to submit open-ended comments on their decisions in the experiment.

The experiment was conducted in eight 16-subject sessions at the Behavioural Laboratory at the University of Edinburgh (BLUE), using the software z-Tree (Fischbacher, 2007). The participants were randomly recruited by the BLUE recruitment system and most were students at the University of Edinburgh. Subjects could only participate in a single experimental session. Thus, no subject had any prior exposure to our experimental design.

To summarize, there were 4 sessions for each of two treatment orderings, GP (Group-Pair) and PG (Pair-Group), each session involving 16 subjects (for a total of 128 subjects in 8 sessions). Each subject made 24 information choices (18 in a Group formation and 6 in a Pair formation), and 36 urn guesses (24 in a Group formation and 12 in a Pair formation). Each session lasted approximately 1 hour 44 minutes, and the average earnings (including £5 show-up fee and £3 reward for completing post-experimental survey) were £17.30 in the GP ordering and £18.23 in the PG ordering.

[4]Due to a non-consequential coding error, in two sessions of the PG treatment ordering, the content of social information was not displayed in the end-of-round feedback *only* in the 10th round (out of 12 rounds) to 8 subjects in the "Pair" formation. As all subjects' decisions were coded correctly, and since we could not detect any difference between the decisions of the affected subjects and of the rest of the sample, we decided to retain the data from those sessions. The code was corrected for all other sessions.

[5]We found no systematic order effect - see Appendix C.

4 Results: Overview

In this section, we focus on our two main questions: which information was chosen, and whether the chosen information was used optimally. We are particularly interested in how the information choices compare with equilibrium predictions.

Importantly, whatever the information chosen (private or social), there is never any payoff-relevant motive to contradict that information and guess the opposite state of the world. That is, it is always optimal to *comply* with the information received. Thus, an important measure of the rationality of subjects' choices is *information compliance*, or the rate of correct use of the available information.

In what follows, we will use P1 and P2 to represent subjects in positions 1 and 2, respectively, of the Pair formation and G1-G4 to represent subjects in positions 1-4, respectively, of the Group formation. Given the binary setup of our experiment, there are four potential strategies combining information choice and information use (or compliance). We write **pf** to denote the strategy of choosing private information and following it, and **pn** to denote the strategy of choosing private information and not following it, i.e., guessing that the state of the world is the opposite to the information received. The remaining two strategies are to choose social information and to follow or not follow it, denoted by **sf** and **sn**. The latter strategies are more complicated than the two private information strategies, and require more detailed definition, as discussed later in this section.

Position	**Information Choice**		**Information Use**			
	Private	**Social**	% $\boldsymbol{pf}$	% $\boldsymbol{pn}$	% $\boldsymbol{sf}$	% $\boldsymbol{sn}$
P1	–	–	**91.8**	8.2	–	–
P2	**72.4**	27.6	**66.9**	5.5	24.3	3.3
G1	–	–	**91.8**	8.2	–	–
G2	**82.8**	17.2	**77.1**	5.7	15.4	1.8
G3	40.9	**59.1**	37.6	3.3	**48.7**	10.4
G4	16.4	**83.6**	14.2	2.2	**77.3**	6.3

Table 1: Overall frequencies of information choice and compliance by position. The first two columns give the frequency with which private and social information were chosen by subjects at different positions in the two formation treatments, P and G, while the remaining columns report on the frequency of the four possible strategies: pf, pn, sf, and sn. Modal information choice and information use strategies are in bold.

The aggregate statistics of subjects' behavior are presented in Table 1. Notice first that the private information compliance rate by the first players in each sequence, i.e., those at positions P1 and G1, happened to be the same. Furthermore, this average compliance rate of 91.8% across these two first positions is higher than the average compliance rate of 89.9% ($\chi^2 = 4.3921, p = 0.0361$) by the first players across the 14 studies analyzed in meta-study by Ziegelmeyer et al. (2013).[6] Thus, the average non-compliance rate of 8.2% by the first players provides empirical justification for the perfect equilibrium reported in Proposition 1.

[6]Our own calculations are based on Ziegelmeyer et al. (2013)'s dataset, which refines the dataset of Weizsäcker (2010) and includes an additional study. The meta-dataset contains a total of 31,086 decisions made by more than 3,000 participants in 14 information cascade experiments.

Finding 1. *The average private information compliance rate by the first players in each sequence (at positions P1 and G1) is* 91.8%.

We will address subjects' compliance with information choices more fully later on in section 6.

As for our main object of interest, information choice, Table 1 reveals that the frequency of social (private) information choice is increasing (decreasing) with a subject's position in formation. In particular, in formation treatment G, the majority of subjects switch to choosing social information at position 3, with the proportion of social information choices increasing to 83.6% at position 4. Finally, as we will discuss later in Section 5.1, the frequency of choosing private information at position P2 is significantly lower than at position G2, even though the situation is identical from a rational choice perspective.

Position	**PE**	**More Is Better**	**Emp. Optimal**	**LQRE** ($\mu = 7.33$)
G1/P1	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) = 0.920$
G2/P2	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) + \Pr(\mathbf{pn}) = 0.539$
G3	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) = 0$	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) + \Pr(\mathbf{pn}) = 0.539$
G4	$\Pr(\mathbf{pf}) = 0$	$\Pr(\mathbf{pf}) = 0$	$\Pr(\mathbf{pf}) = 1$	$\Pr(\mathbf{pf}) + \Pr(\mathbf{pn}) = 0.504$

Table 2: Private information choice rates including the frequency of the strategy **pf** (choose private and follow) and **pn** (choose private and not follow): PE predictions and behavioral alternatives.

The optimality of information choice and use can be assessed against the theoretical predictions in Table 2. First, observe that the information choices reported in the first two columns of Table 1 bear some qualitative similarities to the PE theoretical predictions in Table 2 (first column). That is, the majority of subjects choose private information at position 2 and social information at position 4. Second, the biggest departure from the PE predictions is at position G3, where a majority of subjects (59.1%) choose social information, contrary to the equilibrium prediction of private information choice.

Instead, the majority of subjects seem to behave as if they follow a simple "more is better" heuristic. This alternative theory predicts that social information would be chosen once it contains at least two pieces of information, rather than one piece of private information (see Table 2, second column). This "more is better" prediction differs from the PE prediction only at position G3, where, due to equal priors, the content of social information might be completely uninformative due to "ties" in previous guesses.

Finding 2. *The majority of subjects follow the predictions of the PE at positions 2 and 4, but go against the PE prediction at position 3, of the group treatment, choosing social information rather than private information. Overall, subjects exhibit a bias in favor of social information relative to the PE, with this bias being even stronger relative to the empirically optimal strategy.*

The above result can be compared to two other possible alternatives. First, as Weizsäcker (2010) suggests, it is possible that rational subjects optimize with respect to the actual behavior of their opponents rather than some idealized equilibrium. To evaluate this alternative, the third column of Table 2 reports the *empirically optimal* strategies calculated using the empirical data of Table 1 (see Appendix A for details). Choosing private information remains the empirically optimal choice at positions G2/P2 and G3. However, the preceding subjects' compliance with their information choices is so low, and their choices of social information at position G3 are so frequent, that the empirical expected return of 0.6622 from choosing social information and following it at position G4 is very slightly lower than the expected return of $\frac{2}{3}$ (the signal accuracy) from choosing and following private signal.[7] Thus, despite the empirical payoffs favoring the use of private information in all positions, we find substantial frequencies of social information choice, particularly in the last two positions of the group formation treatment.

The second alternative is a *perturbed equilibrium* concept, Logit Quantal Response Equilibrium (LQRE). This noisy best response equilibrium model provides a predicted mixed strategy (over the four strategies **pf**, **pn**, **sf** and **sn**) at each position. This mixed strategy depends on an accuracy parameter μ (see Goeree, Holt and Palfrey 2016), which we estimate to be 7.33 (see Appendix B for details). The estimated LQRE mixture probability of choosing private information (equal to the sum of the frequencies of **pf** and **pn**) is reported in the last column of Table 2. However, neither the empirically optimal analysis nor the LQRE estimates predict the popularity of social information at positions G3 and G4.

Interpreting strategies based on choices of social information is complicated in position G3, where the guesses of the two previous subjects might differ, resulting in ambiguous social information or a "tie". However, if subjects use available information suboptimally, the subject in position G2 is less likely to be correct compared with the subject in position G1, as position G2 allows for an additional strategy of misusing social information. Indeed, as Appendix A reports, the empirical frequency that player 2 is correct is 0.6386, slightly lower than the corresponding frequency of 0.6393 for player 1 (and both are lower than the accuracy of private information, $\frac{2}{3}$).

Indeed, as Table 1 shows, social information was chosen in 59.1% of observations at G3, which is *not* consistent with subjects in position G3 simply randomizing 50:50 (according to a binomial test, $p = 0.0000$). When social information was chosen at G3, the information received was unambiguous (i.e., there were no ties so that $G1 = G2$) in 62.6% of such social information choices, and this social information was followed in 94.4% of such cases (interpreted as **sf**); in the remaining 5.6% of such cases, subjects choose the opposite of the identical two previous guesses, which was interpreted as **sn**. Among the remaining 37.4% of social information choices at G3, the information received *was* ambiguous, i.e., the first two players' guesses were split, so that there was a tie in guesses for each of the two possible states ($G1 \neq G2$). Among such cases of "tied" social information at G3, 62.4% of guesses coincided with the G1 guess (and thus were interpreted as **sf**), while 37.6% of guesses coincided with the G2 guess, contradicting the G1 guess, and thus were interpreted as **sn**.

[7] The empirically optimal strategy of choosing and following private information at position G4 might not have been immediately apparent; indeed, we could only calculate this ex-post. Still, since the game was played for a repeated number of rounds, and subjects received feedback on both types of information, learning the empirically optimal strategy cannot be ruled out.

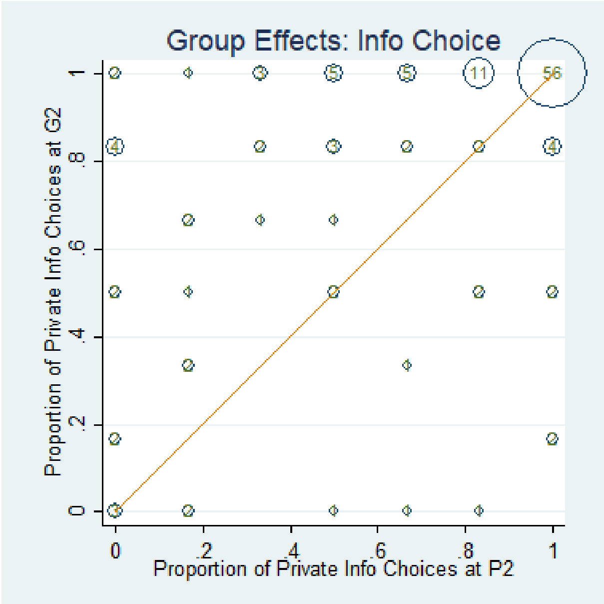

Figure 1: Group Effects: Private information choices at G2 (y-axis) vs. P2 (x-axis), for each of 128 subjects. The size of the bubbles is proportional to the number of subjects (stated within each bubble) with a given (x, y) value. The bubbles located above the 45° line indicate potential group effects.

5 Results: Within-Subject Patterns of Choices

Our within-subject design allows us to compare individual subject behavior at different positions in the sequence of both formation treatments P and G. We are interested in the extent to which individual subject behavior is consistent with the theoretical predictions of Table 2, and how departures from these predictions might be explained.

5.1 Group Effects: Information Choices at G2 vs. P2

As Table 1 reveals, when being second in a sequence, the same subject population chooses private information 82.8% of the time when in the group formation treatment as G2, but only 72.4% of the time when in the pair formation treatment as P2 (Wilcoxon signed-rank test for matched pairs, $z = 3.98, p = 0.0001$). Figure 1 further depicts the rates of private information choices at both positions P2 and G2 by each *individual* subject, with the prevalence of such combination of choices depicted by the relative size of the bubbles. The PE prediction is for 100% private information choices at both P2 and G2. While 56 out of 128 (or 43.8%) observations are at the PE prediction, the majority of subjects' choices differ from this prediction, with pairs of choices lying above the 45° line indicating a greater tendency for the *same* individual subject to choose private information when in G2 than when in P2.

Finding 3. *Subjects choose private information more frequently when they are followed by others in the sequence (i.e. in a group formation).*

The latter finding, which we refer to as the "group effect," is not predicted by the standard theory but has at least two possible behavioral explanations. First, subjects may simply think differently in a larger group of size four than in a pair of players. In our setup, the payoff relevant interaction between two players in a pair is very limited; all that matters is the P1 player's rate of compliance with the signal. By contrast, the group setting provides a more complex framing as both compliance with the signal and the information choices of players in the group have payoff relevant consequences.

Second, subjects may have efficiency motivations that are triggered only in the group setting. As Banerjee (1992) has pointed out, following others in a sequential learning setup can generate a negative herding externality, reducing social welfare. Indeed, Hung and Plott (2001) find that when standard payoffs in social learning models are replaced by majority rule, cascades form significantly less often. As Engelmann and Strobel (2004) have documented, albeit in a different context, some subjects may have concerns for efficiency, desiring to maximize the sum of all participants' payoffs, and not just their own. In the pairs treatment, there is no room for such efficiency concerns as the subject in position 2 (P2) is the terminal player. By contrast, in the group setting, the subject in position 2 (G2) is followed by two more players. Thus, if subjects are able to identify the negative externality of choosing social information and have efficiency concerns, they would choose private information more frequently in position G2 than in the position P2.[8]

5.2 Tie Neglect: Information Choices at G3

As Section 2 showed, the PE optimal strategy at position G3 is to select private information and to follow it, as, two equally precise independent pieces of information are no more informative than only one piece of information with the same precision. Intuitively, the guesses by players G1 and G2 might contradict one another, or "tie", rendering social information at G3 uninformative. In our binary setup the expected frequency of such tie is high enough to offset the informational advantages of the situation when the guesses instead coincide. In particular, the theoretical probability of ties in social information at G3 with full compliance is $2q(1-q)$ (or 44.4% for our parametrization of $q = 2/3$). Such *tie neglect* can only happen in odd-numbered positions like G3, G5, and so on, where social information consists of an even number of previous decisions.[9]

Both PE and LQRE account for such ties and prescribe the choice of private information at G3 (see Table 2), predicting equal frequency of private information choice at positions 2 and 3. Yet as Table 1 reports, 59.1 percent of subjects choose social information at position G3 as compared with 27.6 (17.2) percent choosing social information at P2 (G2), suggesting tie-neglect. This result is disaggregated by individual subject choice pairs at G3 vs P2 (left panel) and G3 vs. G2 (right panel) in Figure 2, demonstrating that the frequency of private information choice at G3 is significantly lower than that at positions P2 and G2 (Wilcoxon signed-rank test $z = 5.96, p = 0.0000$ and $z = 8.228, p = 0.0000$, respectively). Specifically, in the G3 vs. P2 comparison (Figure 2, left panel), more ob-

[8] Given our parameterization, the success rate of a subject who chooses and follows social information in position G4 increases by 10.3% when all of her predecessors reveal their private information - see Ma (2018).

[9] The problem of "ties" is undoubtedly familiar to readers of this paper who serve as journal editors. Two referee reports may result in a split verdict on the suitability of a paper for publication. In that case, this "social" information may well be less useful than another private draw, either from a third referee report, or from a careful reading of the paper by the editor him/herself.

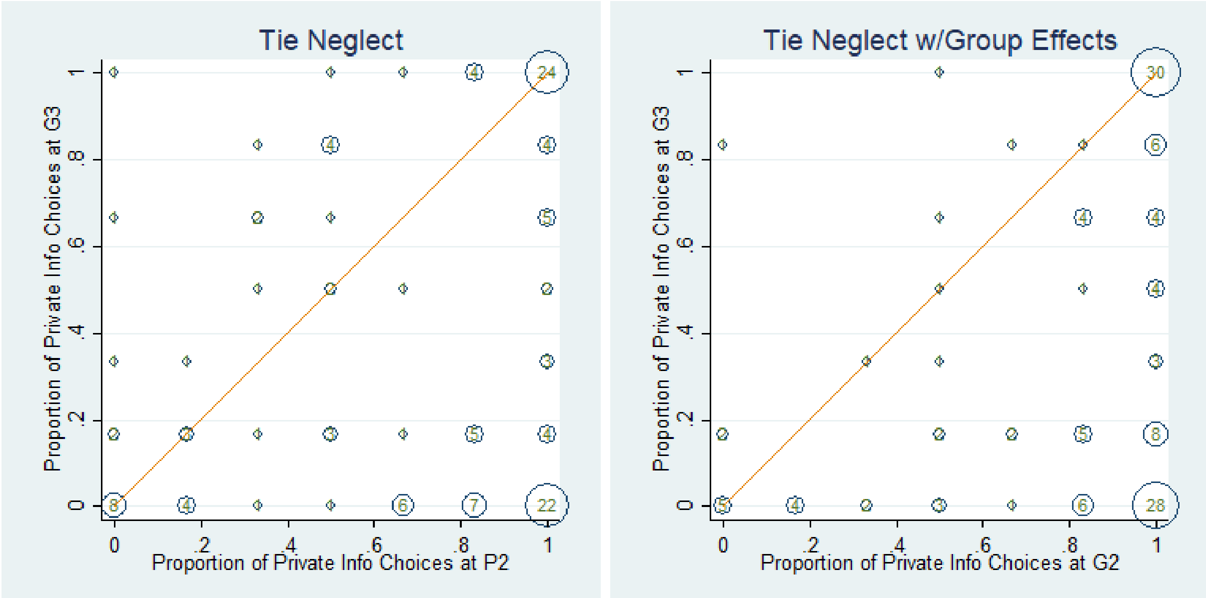

Figure 2: Tie Neglect: Number of private information choices at G3 (y-axis) versus at P2 (x-axis in the left panel) and G2 (x-axis in the right panel), for each of 128 subjects. The size of the bubbles is proportional to the number of subjects (stated within each bubble) with a given (x, y) value. The bubbles located below the 45° line indicate potential "tie neglect".

servations are located below the 45° line, suggesting that more subjects choose private information less frequently (and thus choose social information more frequently) at position G3 as compared to their terminal position P2 in the "Pair" formation. This tie neglect is even more pronounced when comparing pairs of decisions at G3 and G2 (Figure 2, right panel).

Tie neglect (ignoring the possibility of independent signals contradicting one another) differs from redundancy neglect (the failure to recognize that prior actions may be correlated due to social learning) which was first documented by Eyster et al. (2015). Both contribute to sub-optimally over-reliance on social information (and could jointly be due to subjects following simple rules of thumb such as evaluating information simply by counting the number of guesses it includes).

Finding 4. *Subjects choose social information more frequently at position G3 than at positions G2 and P2.*

5.3 PE: Information Choices at G4 vs. P2 and G4 vs. G2

We next examine whether subjects behaved according to the theoretical predictions at position G4. As Table 2 indicates, both the PE and the LQRE predict that the frequency of private information choice at G4 should be lower than at P2, G2, and G3. However, the empirically optimal choice involves never choosing social information at G4. As discussed in the previous section, subjects might be susceptible to social information bias at position G3 due to "tie neglect", and to private information bias at position G2 due to "group effects".

Thus, the pair of frequencies with which each subject chose private information at

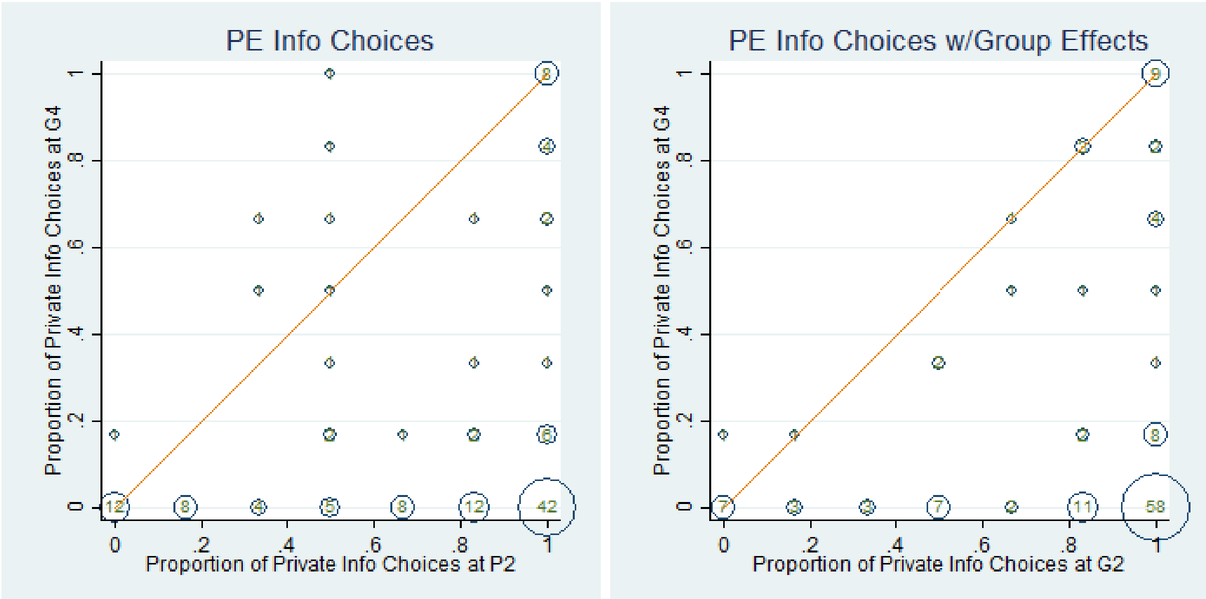

Figure 3: PE: Number of private information choices at G4 (y-axis) versus at P2 (x-axis in the left panel) and versus at G2 (x-axis in the right panel), for each of 128 subjects. The size of the bubbles is proportional to the number of subjects (stated within each bubble) with a given (x, y) value. The bubbles located below the 45° line indicate a tendency in favor of the PE information choice.

the terminal positions G4 and P2, as shown in the left panel of Figure 3, provides us with insight into subjects' abilities to select information according to the PE. The large cluster at the bottom right corner, around the coordinate pair (1,0), represents subjects who behave according to the PE and always choose private information at P2 and social information at G4. The smaller cluster at the bottom left corner, around the coordinate pair (0,0), represents subjects who always choose social information, which is consistent with the PE prediction at position G4 but not at position P2. The other smaller cluster at the top right corner, around the coordinate pair (1,1), represents subjects who always choose private information, and whose behavior is consistent with the PE at position P2 but not at position G4. The two extreme clusters of "herd animals" (who always choose social information at coordinate pair (0,0)) and "lone wolves" (who always choose private information at coordinate pair (1,1)) were also found earlier in Duffy et al. (2018). Overall, as the left panel of Figure 3 makes clear, subjects choose private information at G4 much less often than at P2 (Wilcoxon signed-rank test $z = 9.06, p = 0.0000$).

While choosing private information at every position turned out to be empirically optimal, as well as the most frequent choice according to the LQRE prediction, observe that the number of such "lone wolves" is comparable to the number of "herd animals" - whose behavior is suboptimal. Furthermore, while the combination of private information choices at positions G4 and G2 is a noisier indicator of subject's optimality because of potential group effects, nevertheless the right panel of Figure 3 presents a very similar result to the left panel (G4 vs. P2), namely: subjects choose private information at G4 much less often than at G2 (Wilcoxon signed-rank test $z = 9.62, p = 0.0000$).

Finding 5. *A majority of subjects switch from choosing private information at positions P2 and G2 to choosing social information at position G4, in accordance with the PE (see Section 2), but there are also some (suboptimal) "herd animals" and (empirically optimal) "lone wolves".*

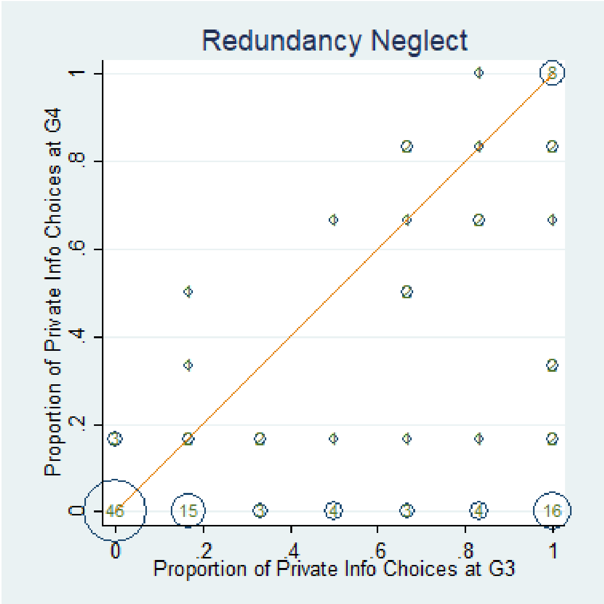

Figure 4: Redundancy Neglect: Proportion of private information choices at G4 (y-axis) versus at G3 (x-axis), for each of 128 subjects. The size of the bubbles is proportional to the number of subjects (stated within each bubble) with a given (x, y) value. The bubbles located below the 45° line indicate tendency for PE/redundancy neglect information choice.

5.4 Redundancy Neglect: Information Choices at G4 vs. G3

As shown above, subjects display a remarkable degree of PE behavior at position G4, involving the choice of social information. While the return to social information at G4 is reduced by the preceding subjects not following their information (either social or private), we show in Appendix A that choosing private information at G4 is the empirically optimal strategy primarily because of the popularity of social information at G3. Indeed, if subjects in position G2 or G3 choose social information, their guesses will be correlated with the guesses of the previous subjects, making social information at position G4 less informative. That is, the frequency with which social information is chosen at G4 suggests "redundancy neglect", as defined by Eyster et al. (2015), the failure of subjects to realize that guesses at G3 are not in fact independent of guesses at G1 and G2.

Figure 4 plots the distribution of each subjects' paired frequencies of information choices at positions G4 and G3. The big cluster at the bottom left corner around the coordinate pair, (0,0) represents subjects who always chose social information at both positions G3 and G4, including "herd animals" (who choose social information at all positions), and also those who may suffer both from "tie neglect" and from "redundancy neglect". The medium cluster at the bottom right corner around the coordinate pair (0,1) is consistent with PE behavior. Finally, the small cluster at the top right corner around the coordinate pair (1,1) represents "lone wolves", who always choose private information (which is in fact empirically optimal given others' behavior). Overall, subjects choose private information at G4 significantly less often than at G3 (Wilcoxon signed-rank test $z = 6.49, p = 0.0000$).

Finding 6. *More subjects choose social information at position G4 than at G3. While this is consistent with PE behavior, it is nevertheless empirically suboptimal due to the rate of non-compliance and social information choice at earlier positions.*

5.5 Summary of Overall Patterns in Information Choices

The above-mentioned patterns in subjects' information choices are well-captured by a random-effects probit regression analysis reported on in Table 3. This regression makes use of all of the information choice data (when subjects are in positions P2, G2, G3 and G4). Relative to position, P2, we observe that subjects exhibit group effects at position G2 by choosing (optimally) private information more often, tie neglect at position G3 by choosing (suboptimally) social information more often, and, finally, PE and redundancy neglect at position G4 by choosing (empirically suboptimally) social information more often. We further find that there are no order effects as the coefficient on the dummy variable for the Group-Pair treatment ordering (GP) is insignificantly different from zero, nor is there any time trend (round number) as indicated by the insignificant coefficient on the "time" variable.

	$Private_{i,t}$
G2	0.54***
	(0.14)
G3	-1.19***
	(0.16)
G4	-2.37***
	(0.22)
GP	-0.20
	(0.20)
time	0.00
	(0.01)
_cons	0.91***
	(0.16)
Wald χ^2	180.88
p-value	0.00
No. Obs.	3072.00

Table 3: Random-effects probit regression with binary dependent variable $Private_{i,t}$ which is equal to 1 (0) when subject i chooses private (social) information in round t, for all 128 subjects at all 24 information choice positions. G2-G4 are dummy variables. Baseline: position P2 in the PG treatment ordering. Robust standard errors (in brackets) are clustered at the group level. (* p-value < 0.10, ** p-value < 0.05, *** p-value < 0.01).

Finding 7. *Private information is chosen more frequently at position G2 (in a group) than at position P2 (in a pair). Contrary to PE predictions, there is a strong bias towards social information at position G3. Finally, at position G4 social information is chosen more frequently, which is PE optimal, but empirically suboptimal because of the rate of non-compliance, and social information choice at earlier positions.*

The above finding indicates co-existence of both rationality and bias in our data. As we reported earlier in Finding 2, the aggregate data does not indicate any systematic bias toward a particular type of information. However, as Finding 7 states, there is a notable heterogeneity in subjects' tendencies, with many subjects who select information optimally in some positions, but not in others. Moreover, while the choice of social information at position G4 is PE optimal, choosing it is empirically suboptimal and is consistent with a "triple" neglect, - i.e. a combination of tie neglect, redundancy neglect, and non-compliance neglect.

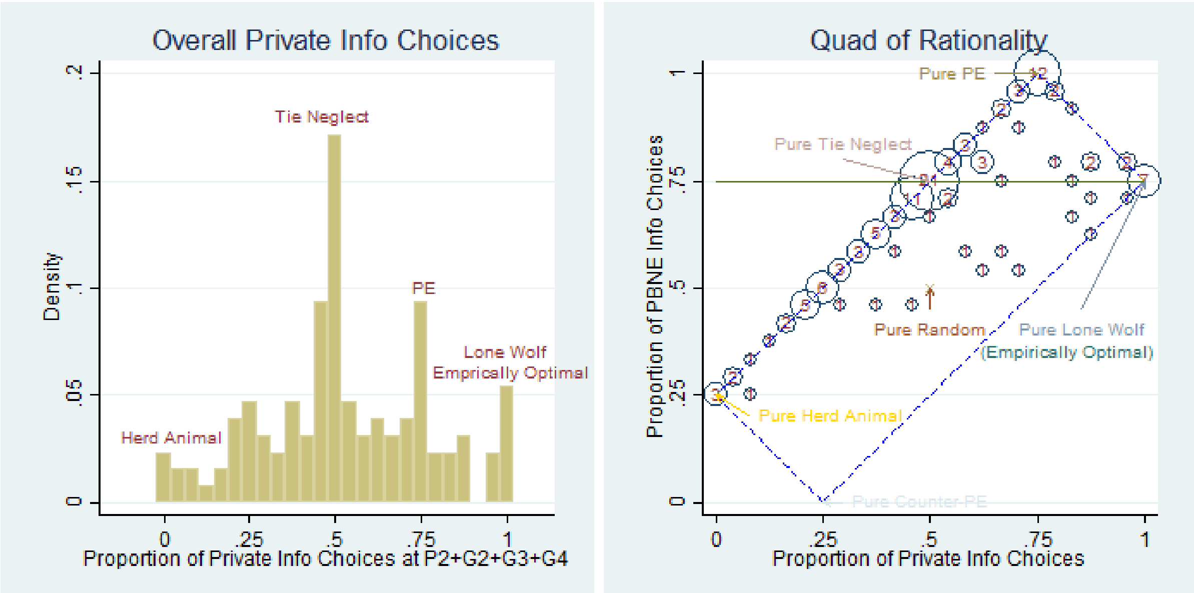

Figure 5: Rates of private and PE information choices, out of all 24 information choices. Left: Distribution of private information choice rates at all positions (P2, G2, G3, and G4) for all 128 subjects. Subjects who always choose social (private) information are located on the left- (right-) hand side of the range. Right: Rates of PE information choices (y-axis) vs. rates of private information choices (x-axis) for each of 128 subjects. The size of the bubbles is proportional to the number of subjects with a given pair of values. By construction, the values are constrained by the dashed lines.

A histogram of the aggregate rates of private information choices at positions P2, G2, G3 and G4 (Figure 5, left panel) reveals a mixture of bias and rationality, as the distribution of these choices is widely distributed with multiple spikes. At the far left of the figure, there are "herd animals," who never or almost never choose private information. At the opposite corner, there are "lone wolves," who almost always choose private information regardless of their position. The largest spike is at the 0.5 proportion, where most subjects choose private information at position 2 in both the "Pair" and "Group" formations, and switched to social information at position G3 (possibly due to "tie neglect") as well as at position G4 (optimal). A smaller spike at the 0.75 proportion depicts subjects who mostly switched to social information only at position G4, corresponding to the PE. The rest of subjects are not "pure" in terms of their information choices; some of them either update their strategies during the experiment, or do not have stable strategies. Overall, the mean (SD) proportion of private information choices is 0.531 (0.246) and this is marginally greater than the median and modal value of 0.5 (one-tailed t-test, $p = 0.077$), suggesting a strong presence of tie neglect, and a substantial presence of PE behavior.

The right panel of Figure 5 represents the same data as the joint distribution of private information choice rates with PE choice rates,[10] and provides a graphical representation of many features and findings of our experiment. First, the dashed lines represent the constraints on the measures of behavior. For instance, always choosing social information would be consistent with the PE only 25 percent of the time, namely when in position G4, hence one vertex of the "quad of rationality" is at the coordinate pair (0,0.25). The other three vertices follow from the same type of reasoning, and the dashed lines connecting these vertices provide logical bounds upon the set of all observations. Second, the largest

[10]The mean (SD) of PE choices is 0.699(0.185), with an empirical range of $[0.25, 1]$.

group of subjects exhibits "tie neglect", at coordinate pair (0.5,0.75) which is the novel bias towards social information that we have identified in our design. Third, a substantial group of subjects always made PE information choices (coordinate pair (0.75,1). Finally, there are a noticeable cluster of empirically optimal "lone wolves" at coordinate pair (1,0.75) and a smaller cluster of suboptimal "herd animals" at coordinate pair (0,0.25).

Finding 8. *Relative to the PE, there is substantial individual heterogeneity in information choices. A large group of subjects suboptimally chose social information at position G3. PE emerges as the second most prominent behavior, with some (empirically optimal) "lone wolf" and (suboptimal) "herd animal" types.*

6 Results: Information Compliance

Finally, the proportion of subjects' guesses that followed the information provided at each of the six positions (i.e., P1-P2 and G1-G4) are reported in Table 4.

Pair				Group			
Position	**Private**	**Social**	**Overall**	Position	**Private**	**Social**	**Overall**
P1	91.8	–	91.8	**G1**	91.8	–	91.8
P2	92.4	88.2	91.3	**G2**	93.1	89.4	92.4
–	–	–	–	**G3**	92.0	82.4	86.3
–	–	–	–	**G4**	86.5	92.5	91.5

Table 4: Frequencies of information compliance by position within each formation.

The overall compliance rates (which are equal to the sum of % **pf** and % **sf**, from Table 1) are in excess of 85 percent at all positions. Moreover, apart from the complex case of position G3, there is hardly any difference in compliance rates by those choosing private or social information (suggesting that the confusion/mistakes in use of information might be due to some process which is independent of the type of information chosen). This is possibly because the incentives to comply with private and social information are broadly similar and are determined by signal accuracy. First, the expected payoff to compliance with a private signal is always 2/3, and to non-compliance it is 1/3. Second, the expected payoff to compliance with social information varies both with position in the sequence and the behavior of other subjects. In Appendix A, we calculate the empirical return to social information in the experiment, and find that its accuracy is similar to, but below that of private information.

The left panel of Figure 6 reveals that more than 30 percent of subjects are perfectly compliant, while at the same time almost 70% of subjects contradict the observed information at least once, including almost 40% of subjects who go against the information they receive at least three times, The worst individual compliance rate is 0.528 (i.e., following the information only a bit more than half of the time). The right panel of Figure 6 shows that, at the individual level there is a positive correlation between information compliance in the first periods, P1+G1 (where private information is provided by default), and information compliance in all subsequent positions, P2+G2+G3+G4.

Finding 9. *In all positions, subjects optimally complied with the information available to them more than 85 percent of the time. However, a large majority of subjects, 67*

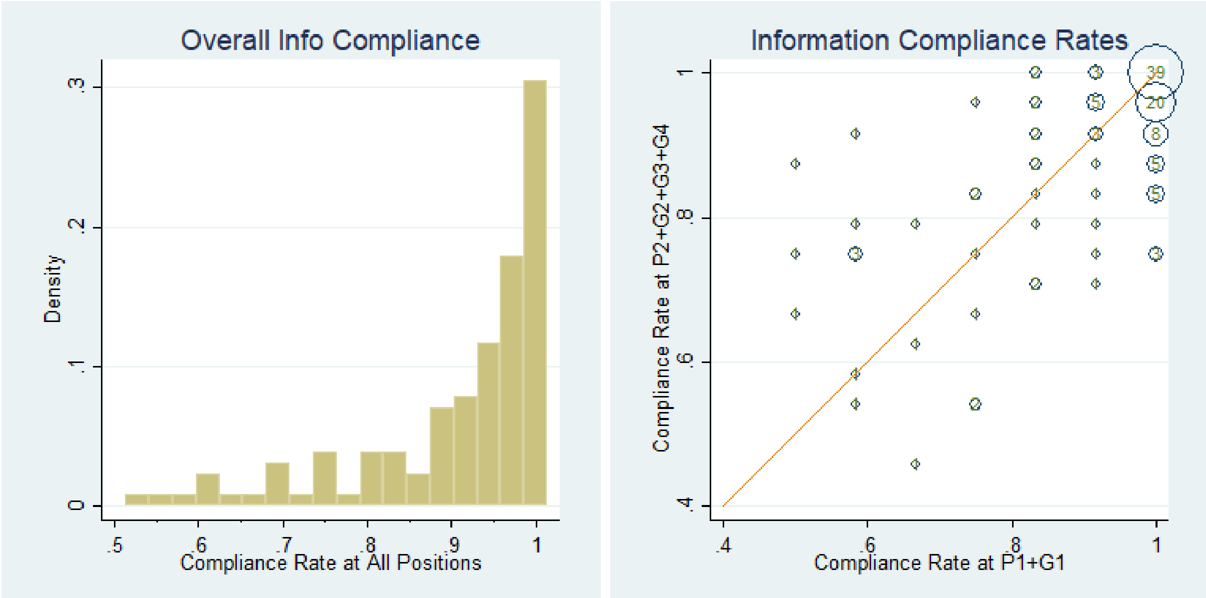

Figure 6: Information compliance rates, or proportions of guesses where subjects followed the received information (N of subjects = 128.) Left panel: Distributions of information compliance rates at all positions combined (P1-P2 and G1-G4). Right panel: Comparison of compliance rates at non-information choice positions (P1 and G1) versus positions involving information choice (P2 and G2-G4).

percent, used information suboptimally at least once, either going against their private signal and/or the social information they chose to receive.

7 Conclusion

Our experiment modifies the standard sequential social learning environment to yield important new insights about information use and group decision-making. In our setting, subjects have to choose to observe either a private signal or the history of decisions made by earlier subjects in the sequence (social information) rather than having both types of information freely supplied to them. In contrast to the standard sequential social learning setting, our experiment with information choice enables a meaningful within-subject design, where the same subjects can be assigned to different positions in a sequence in order to test theoretical predictions that depend on a player's position in the sequence. In addition, our within subject analysis allows for the detection of any individual biases for or against social information.

Our findings suggest that many subjects employ a "more is better" heuristic to valuing social information, despite the fact that this heuristic suffers from a "triple neglect" of factors that work to diminish the value of social information. First, many subjects choose social information after the first two guesses, i.e., at position 3, perhaps following the notion that "two heads are better than one", but this logic ignores the (very likely) possibility that the two heads may disagree with one another. We call the latter phenomenon tie neglect. Second, choosing social information later in the sequence may not be optimal because earlier subjects may already have chosen social information reducing its informativeness. Not realizing this possibility is known as redundancy neglect. Third, we document that almost 70% of our subjects fail to comply with the information they receive at least once which further erodes the value of social information. We label the failure to recognize that possibility as non-compliance neglect. These findings challenge the validity of many earlier social learning studies where mistakes made by subjects can only be identified in those infrequent cases where both social and private information agree and yet the subject's choice is at odds with that information.

Here, while some subjects are unbiased and choose information according to theoretical or empirically optimal strategies, mostly we find subjects who simply choose social information too early, applying a "more is better" heuristic, and succumbing to "triple neglect". In the aggregate, we thus find an overall bias against private information. This is in contrast to the bias towards overweighting private information, documented in the metastudy of Weizsäcker (2010) for the standard sequential setting - which, by design, favors mistakes towards overusing private information. This is in further contrast to Duffy et al. (2018) who considered a design where mistakes can run both ways, and found equal numbers of "herd animals" who consistently choose social information, and "lone wolves" who repeatedly choose private information. Overall, this suggests that asymmetry in the experimental design may be a significant confound in identifying the level and type of bias for or against social information.

Our results further indicate that when a subject's decision can be observed by followers, she chooses private information more frequently than when there are no subsequent players. By choosing and acting according to that private information, an individual can help followers by increasing the informativeness of social information. Such group effects could be one explanation for why subjects were found to be biased toward private information in standard social learning experiments relative to equilibrium predictions based on self-interest.

In summary, we observe heterogeneity in information choice in a sequential social learning environment. We believe that our findings have important practical implications, one of which would be for mechanism design. In situations where a social planner is able to determine the sequence of decision making, lone wolves should be positioned at the beginning of the sequence and herd animals should never be positioned earlier in the sequence. Alternatively, it is also possible that if lone wolves and herd animals coexist, that an endogenously formed sequence can be self-enforcing efficient, as the lone wolves should prefer to be the leaders in the sequence if waiting is costly, and the herd animals and rational individuals may rationally choose to be in later positions in the sequence to wait for the more valuable social information generated by the early-moving lone wolves. We leave such an extension to future research.

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Appendices

A Empirically Optimal Strategy

In this appendix, we set out how the empirically optimal strategies at each position $n \in \{1, 2, 3, 4\}$ are calculated. The empirical frequencies of strategies pf_n (pn_n), choosing private information and following (not following) it, as well as of strategies sf_n (sn_n), choosing social information and following (not following) it are taken from Table 1.

The expected return to using and misusing private information are always $\pi(pf_n) = q = \frac{2}{3}$ and $\pi(pn_n) = 1 - q = \frac{1}{3}$, respectively. The empirical frequency that player 1 is correct is $p_1 = pf_1 q + pn_1(1 - q) = q - (2q - 1)pn_1 < q$. Thus, the empirical return to following social information at position 2, is $\pi(sf_2) = p_1 = 0.6393 < q$. The empirical frequency that player 2 is correct is $p_2 = pf_2 q + pn_2(1-q) + sf_2 p_1 + sn_2(1-p_1) = 0.6386 < q$.

The empirical return to following social information at position 3, $\pi(sf_3)$, by definition, is the return to following the majority when it exists, or following the player in position 1 in case of a tie. Thus, $\pi(sf_3) = p_{11} + p_{10}$, where p_{11} is the empirical frequency that players 1 and 2 are correct in their guesses, p_{10} is the empirical frequency that player 1 is correct and player 2 is wrong. Taking into account that the success of the players are not independent when a player chooses social information, we have:

$$\pi(sf_3) = p_1(pf_2 q + pn_2(1 - q)) + p_1 sf_2 + p_1(pf_2(1 - q) + pn_2 q) + p_1 sn_2 = p_1.$$

Thus, the returns to social information at positions 2 and 3 are identical (see Ma (2018)):

$$\pi(sf_3) = \pi(sf_2) = p_1 = q - (2q - 1)pn_1 = 0.6393 < q.$$

Non-compliance at position 1 (pn_1) reduces the return to social information at position 3 from 2/3 to 0.639. However, surprisingly the frequency with which social information is chosen at position 2 has no effect.

At position 4, the theoretical payoff to sf_4, choosing social information and following the majority of the three previous players, is $q^3 + 3q^2(1 - q) = 20/27 \approx 0.741$ higher than $q = \frac{2}{3}$. However, the empirical return to sf_4 turns out to be lower:

$$\pi(sf_4) = p_{111} + p_{110} + p_{101} + p_{011} = 0.6622 < q$$

where p_{111} is the empirical frequency that players 1, 2 and 3 are correct in their guesses, p_{110} is the empirical frequency that 1 and 2 are correct and 3 is wrong, and so on. The calculations above take into account that, given that some players choose social information, the success of the players are not independent. For example, if player 1 is correct, then if player 2 chooses social information, she will be correct too if she follows it, and so on, and thus

$$p_{111} = p_1(pf_2 q + pn_2(1 - q) + sf_2)(pf_3 q + pn_3(1 - q) + sf_3).$$

If, instead, player 1 is incorrect, then if player 2 or player 3 choose social information, either will be correct if she does not follow (again we define following in position 3 by following player 1 if players 1 and 2 disagree), and thus

$$p_{011} = (1 - p_1)(pf_2 q + pn_2(1 - q) + sn_2)(pf_3 q + pn_3(1 - q) + sn_3).$$

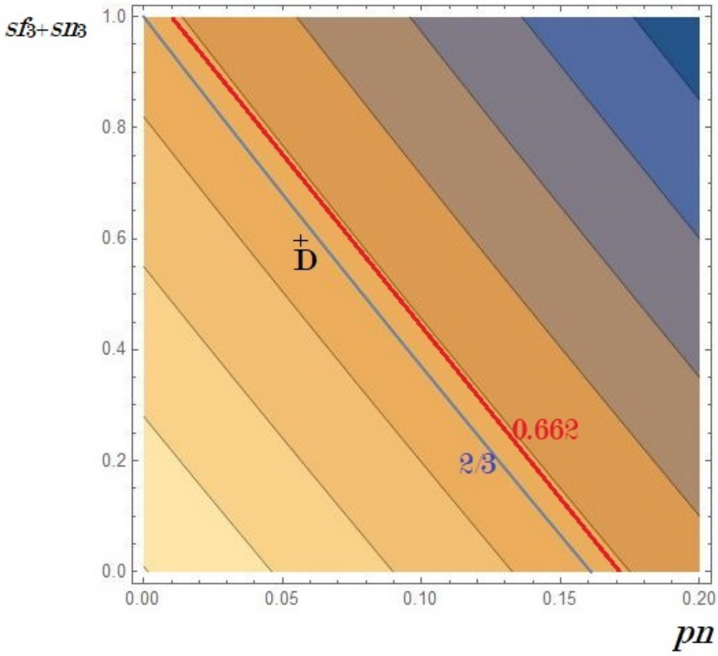

Figure A.1: Decomposing the return to social information at position 4: Level curves for $\pi(sf_4)$. Rate of non-compliance pn (on y-axis) vs. frequency of choice of social information $sf_3 + sn_3$ at position 3 (on y-axis), with the empirical average denoted by D. The maximum value $\pi(sf_4) = q^3 + 3q^2(1-q) = 20/27 \approx 0.741$ at the origin. The level curve representing the empirical average of $\pi(sf_4) = 0.662$ is in red, and the level curve representing the return to private information $q = \frac{2}{3}$ is in blue.

We thus calculate that $p_{111} = 0.3604$, $p_{110} = 0.0795$, $p_{101} = 0.1261$ and $p_{011} = 0.0962$, which gives the expected return to social information for player 4 at 0.6622 as above.

To decompose the effect of non-equilibrium behavior on the return to social information at position 4 is somewhat complicated. However, suppose that the rate of non-compliance to private information is equal to a constant pn at positions 1, 2 and 3. Suppose further that $sf_2 = sn_2 = 0$, no-one chooses social information at position 2. Then, the return to social information at position 4 is

$$\pi(sf_4) = q^3 + 3q^2(1-q) - (1-q)^3\left(12pn + 3pn^2 - 2pn^3 + (2-pn)(1+pn)(sf_3 + sn_3)\right)$$

Both the rate of social information choice at position 3 and the non-compliance rate have a negative effect on the return to social information at position 4. Further, the marginal rate of loss from one of these factors is increasing in the other - they reinforce each other.

We can form some further numerical experiments to determine the relative contribution of these two factors. If we set pn equal to its average empirical value, 0.0573, over the first three positions, while holding $sf_3 = sn_3 = 0$, then $\pi(sf_4)$ falls from $20/27 \approx 0.741$ to 0.715. If we set pn to zero, and $sf_3 + sn_3 = 0.591$, their empirical value, then $\pi(sf_4)$ falls from $20/27 \approx 0.741$ to 0.697. This suggests that it is the popularity of social information at position 3 that is particularly damaging to its value at position 4. If we set pn, sf_3 and sn_3 to their empirical values, then $\pi(sf_4)$ falls from $20/27 \approx 0.741$ to 0.6700, whereas the actual payoff was almost identical at 0.6622. That is, these two factors together almost completely explain the low empirical return to social information at position 4. This is illustrated in Figure A.1.

B Logit QRE

An alternative theoretical framework is Logit Quantal Response Equilibrium (LQRE) due to Mckelvey and Palfrey (1995). LQRE has two main advantages. First, LQRE takes the widely observed "trembling hand" behavior into consideration, and the level of tremble can be estimated from real experimental data. In addition, instead of a sharp 1 or 0 strategy prediction from PE, LQRE generates predictions in terms of frequencies.

We normalize the payoffs to correct and incorrect guesses to 1 and 0, respectively; and thus the payoff $\pi(j)$ to a strategy j is its probability of it resulting in a correct guess. A player's optimality is captured by the parameter μ with $0 < \mu < \infty$: the higher μ is, the closer is $player_i$ to optimal behavior.

The first player in the sequence faces only two options, to follow the private signal (**pf**) or not (**pn**), thus the LQRE probability of (optimal) following the private signal is:

$$pf_1 = \frac{e^{\mu \cdot \pi(pf_1)}}{e^{\mu \cdot \pi(pf_1)} + e^{\mu \cdot \pi(pn_1)}} \tag{2}$$

All subsequent players in the sequence face all four strategies, and thus the LQRE probability of following the private signal at position n is:

$$pf_n = \frac{e^{\mu \cdot \pi(pf_n)}}{e^{\mu \cdot \pi(pf_n)} + e^{\mu \cdot \pi(pn_n)} + e^{\mu \cdot \pi(sf_n)} + e^{\mu \cdot \pi(sn_n)}}, \forall k \geq 2 \tag{3}$$

Of course, $\pi(pf_n) = \frac{2}{3}$ for all n, the accuracy of a private signal. The payoffs to social information are endogenous and are calculated in the same way as in the empirical optimal calculations (in Appendix A above), but using the LQRE frequencies. For example, the return to following social information at position 2 is $p_1 = pf_1 q + pn_1(1-q)$ as before, but pf_1 is calculated using the logit equation (2). Note that as given in (A), the return to social information is the same at positions 2 and 3. Consequently, the LQRE strategy frequencies do not change from position 2 to 3.

In general, the predictions of LQRE depend on the value of μ, the precision parameter. For players in positions 2 and 3, the qualitatively robust prediction is that they choose private information more frequently than social, as mistakes by prior players reduce the expected accuracy of social information. However, at position 4, the value of μ does matter for determining the modal strategy choice. If μ is sufficiently low, then even in position 4, play is noisy enough to render social information to be less accurate than private. Since play frequencies in LQRE reflect relative payoffs, this induces the LQRE to place greater probability on pf than sf in position 4 if μ is below some threshold value $\hat{\mu}$. One can calculate that for $\mu < \hat{\mu} = 8.42$, the modal action is to choose private information.

Position	$\boldsymbol{pf}$	$\boldsymbol{pn}$	$\boldsymbol{sf}$	$\boldsymbol{sn}$
1	$pf_1 = 0.920$	$pn_1 = 0.080$	–	–
2	$pf_2 = 0.496$	$pn_2 = 0.043$	$sf_2 = 0.408$	$sn_2 = 0.052$
3	$pf_2 = 0.496$	$pn_2 = 0.043$	$sf_2 = 0.408$	$sn_2 = 0.052$
4	$pf_4 = 0.464$	$pn_4 = 0.040$	$sf_4 = 0.455$	$sn_4 = 0.041$

Table B.1: LQRE estimations for each position, for $\mu \approx 7.330$.

We estimate the value of μ using maximum likelihood to maximize the fit to the empirical frequencies given in Table 1. The log likelihood is

$$\log P = C + \hat{pf}_1 \log(pf_1) + \hat{pn}_1 \log(pn_1) + \hat{pf}_2 \log(pf_2) + ... + \hat{sn}_4 \log(sn_4) \tag{4}$$

where C is a constant, $\hat{pf}_i$ indicates the frequency of that strategy in the data and pf_i the theoretical probability of the strategy as given in (2) or (3). The value of μ that maximizes this likelihood is $\mu = 7.330$. This is then used to generate the strategy frequencies given in Table B.1. The value for μ is below $\hat{\mu}$, so with the estimated empirical return, the LQRE predicts social information is less accurate than private even at position 4. Indeed, the LQRE value for $\pi(sf_4) = 0.6639$ is very close to the estimated empirical value of 0.6622. This is below the return to private information of $\frac{2}{3}$. Thus, the LQRE frequencies place a greater weight on pf_4 than sf_4.

C Order Effect

As Figure C.1 shows, the distributions of information choices do not differ significantly between "GP" and "PG" treatment orderings (two-sample Kolmogorov-Smirnov test $p =$ 0.84). Using Mann-Whitney test, we find no difference in information choices between the two treatment orderings at position 2 in both "Pair" (72.7 vs. 72.1, p=0.87) and "Group" (82.0 vs. 83.6, p=0.57) formations; but subjects in "PG" treatment ordering are more likely to choose private information at positions G3 (35.9 vs. 45.8, p=0.01) and G4 (13.8 vs. 19.0, p=0.05). However, controlling for individual differences among subjects, there is no order effect in the regression results in Section E.

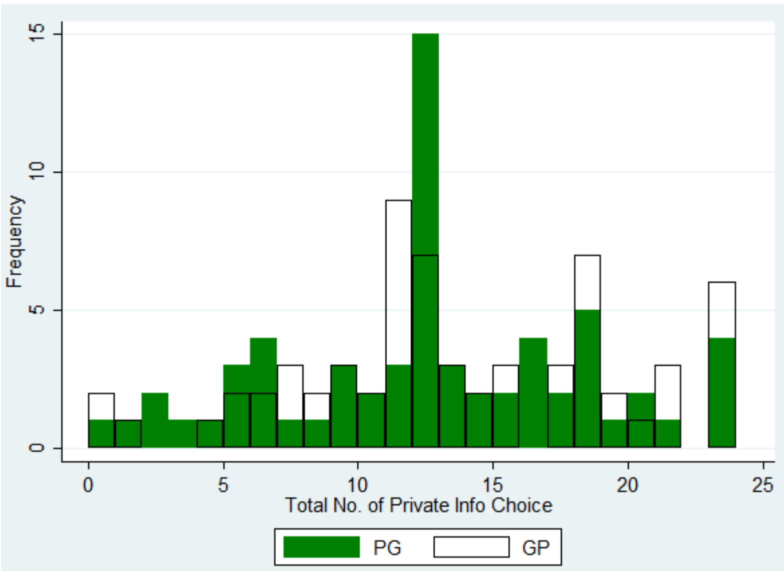

Figure C.1: Distributions of total number of private information choices, by treatment ordering: PG (green) vs. GP (white), for 64 subjects in each treatment ordering.

D Cognitive and Non-Cognitive Individual Characteristics

In the third part of the experiment, we collected self-reported individual characteristics. Out of 128 subjects, 33.6% were males and 66.4% females. While a significant majority (84.4%) of our subjects are undergraduate students, the average (median) age is 22.9 (21) years, as our participants included mature students, postgraduate students, as well as a small number (3.1%) of non-students.

To quantify subjects' cognitive abilities, we used a multiple choice version of Frederick (2005)'s free-form Cognitive Reflection Test (CRT), (labeled CRT_{MCQ} (multipl,e choice question (MCQ) format). This test is frequently used to differentiate between "system 1" and "system 2" thinking (Kahneman (2011)) as the three questions each have an obvious but incorrect answer reflecting system 1 type thinking. The correct answer requires more deliberative reflection, or system 2 thinking. Thus, higher CRT scores are associated with higher cognitive reflection, and thus possibly lower rates of non-compliance neglect, tie neglect or redundancy neglect. The CRT scores range between 0 and 3, and the mean (SD) CRT score in our experiment is 1.29 (1.18) and the median is 1.

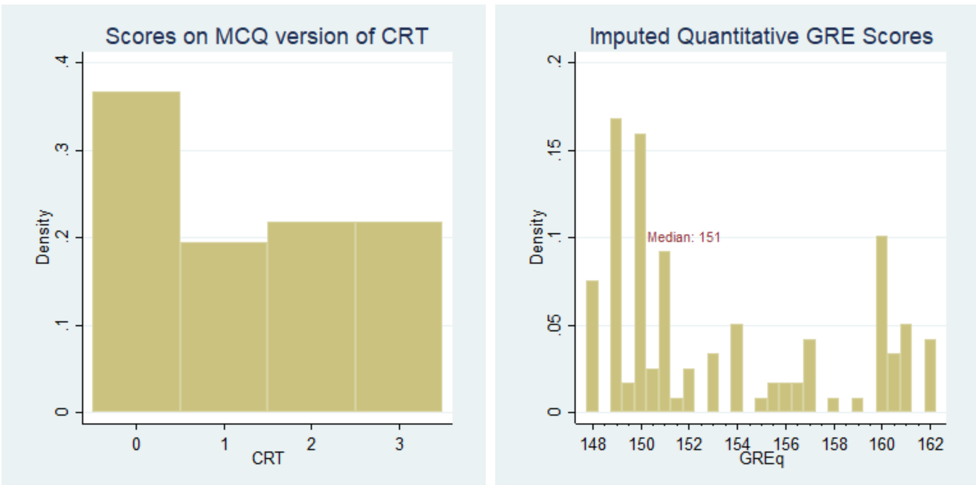

Figure D.1: Distributions of CRT_{MCQ} for all 128 subjects (left panel), and GRE_Q for the applicable 119 subjects (right panel).

Following a methodology used in Duffy et al. (2017), we also imputed subjects' cognitive abilities based on subjects' self-reported programme of university study (or major). Specifically, we used the average scores on the quantitative section of the GRE General Test (GRE_Q) associated with each subjects' self-reported programme of study, or "major" (see Educational Testing Service (2014, Table 4) as the subjects' assigned GRE quantitative score, labeled GRE_Q. We were able to impute GRE_Q scores for 119 subjects (the remaining 9 subjects were either not associated with any university programme, or the GRE scores were not available for their self-reported programme of study). The mean (SD) imputed GRE_Q score is 153.63 (4.51) and the median is 151. These two cognitive proxies, CRT_{MCQ} and GRE_Q, are highly correlated in our data with a correlation coefficient $r(CRT_{MCQ}, GRE_Q) = 0.30$ that is significantly positive p-value$= 0.00$, Further, males have higher values of both cognitive proxies as reported in Table D.1. Figure D.1 provides the distributions of these two proxies.

	female	Age	CRT_{MCQ}	GRE_Q
female	1			
age	-0.142	1		
CRT_{MCQ}	-0.276***	0.061	1	
GRE_Q	-0.437***	-0.003	0.305***	1
F1Contra	-0.181**	0.131	0.079	0.240***
F2SocReg	-0.133	-0.182**	0.016	0.051
F3ToM	0.020	-0.094	-0.077	-0.068
F4Altru	0.125	-0.062	-0.055	-0.278***
F5Aloof	-0.179**	-0.037	0.069	0.141
F6Trust	-0.175**	0.032	0.103	0.103

Table D.1: Pairwise correlations between individual characteristics. By construction, factors F1-F6 are uncorrelated with each other. (* p-value< 0.10, ** p-value< 0.05, *** p-value< 0.01.)

Subjects' individual non-cognitive characteristics (sometimes referred to as personality traits), may also affect their behavior in our experiment, – for example, by biasing subjects towards or against a particular type of information.[11] We conducted an individual traits survey with 30 six-point scale questions, using some questions from Costa and McCrae (1992), Duffy and Kornienko (2010), and Duffy et al (2017), as well as our own (see Table D.2). Subjects indicated the extent of their agreement or disagreement with these statements using a 6-point Likert scale.

Based on subjects' responses, we developed proxies for these non-cognitive traits. First, we kept all 30 questions as the standard reliability test statistic, Cronbach's α, is 0.755 and thus satisfied the recommended cut-off value of 0.75. The common factor analysis rendered six factors with eigenvalues greater than unity, with uniqueness values on all questions less than the cut-off value of 0.7, and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy equal to 0.734, a "middling" value (see, e.g. Duffy and Kornienko (2010) for the methodology). Second, we applied a common factor analysis to this survey data, and found 6 latent factors. Based on the signs and magnitudes of the factor loadings as reported in Table D.2, we give these six factors the following interpretations. Factor "F1Contra" (the strongest factor, explaining 30.1% of variability) can be interpreted as a tendency for being contradictory and independent; factor "F2SocReg" (21.7%) represents a tendency for having social regret; factor "F3ToM" (15.3%) is a tendency for having "theory of mind"; factor "F4Altru" (9.5%) is a tendency for altruism; factor "F5Aloof" (8.5%) is a tendency for not being interested in social interactions and being non-rivalrous; factor "F6Trust" (7.2%) is a tendency to trust others.

By construction, the six personality trait factors are themselves uncorrelated. There is also no significant correlation between CRT_{MCQ} and predicted values for any of the six factors. However, we found gender differences in the predicted values of factors for each subject (see Table D.1). Consistent with previous studies (e.g., Weisberg et al, 2011), females are less contradictory (less independent). In addition, males are more socially detached and trust others more. Furthermore, age is negatively correlated with a tendency for social regret, and imputed GRE_Q scores are positively correlated with a tendency to contradict and negatively with tendency to be altruistic.

[11] The effect of personality on information choice is also explored in Fréchette et al. (2017).

Code	Question	Motive	Mean	SD	F1Contra	F2SocReg	F3ToM	F4Altru	F5Aloof	F6Trust	Unique
qal1	Feel indifference to others' misfortunes.[a]	Altruism (-)	2.41	1.10	0.21	**0.40**	-0.19	**-0.45**	0.08	0.13	0.53
qal2	Try not to do favors for others.[a]	Altruism (-)	2.16	0.87	0.06	0.33	-0.12	**-0.41**	0.08	0.04	0.70
qal3	Feel sympathy for those who are less fortunate than me.[a]	Altruism (+)	4.65	1.02	0.05	-0.09	0.36	**0.53**	-0.13	0.13	0.54
qal4	Love to help others.[a]	Altruism (+)	4.48	1.12	0.01	-0.24	0.34	**0.52**	0.01	0.09	0.54
qct2	Behave unconventionally.[a]	Contradict (+)	3.23	1.07	**0.63**	0.13	-0.05	0.03	0.32	0.22	0.44
qct3	Take the opposite route from everyone else.[b]	Contradict (+)	3.38	0.93	**0.67**	-0.01	0.20	0.00	0.29	0.02	0.43
qct4	Run against the crowd.	Contradict (+)	3.30	0.98	**0.76**	0.05	0.08	-0.03	0.22	0.16	0.35
qct5	Am at ease when behaving differently from others.[b]	Contradict (+)	3.74	1.24	**0.52**	-0.18	0.12	-0.03	0.30	0.20	0.55
qct6	Follow others to avoid being the only one making a mistake.	Contradict (-)	2.73	0.95	**-0.53**	**0.53**	0.06	-0.06	0.15	0.01	0.41
qct7	Do what others do rather than rely on my opinion.	Contradict (-)	2.53	0.78	**-0.65**	0.34	-0.04	-0.09	0.26	-0.04	0.39
qct8	Ignore my own gut feeling and instead follow other people.[b]	Contradict (-)	2.70	0.81	**-0.46**	0.38	0.09	-0.09	0.11	0.15	0.59
qct9	Find it easier to follow others than to search for my own path.[a]	Contradict (-)	2.65	0.97	**-0.51**	0.33	0.04	0.02	0.22	0.09	0.57
qctx	Feel uncomfortable to do things differently from the group.[b]	Contradict (-)	2.84	0.95	**-0.40**	0.38	0.03	0.24	0.01	-0.02	0.64
qrv1	Feel that winning or losing doesn't matter to me.[a]	Rivalry (-)	3.07	1.12	**-0.42**	-0.37	0.12	0.03	**0.41**	-0.08	0.50
qrv2	Avoid situations involving competition.[a]	Rivalry (-)	2.99	1.15	**-0.46**	0.09	0.12	0.21	0.28	-0.14	0.62
qrv3	Drawn to compete with others.[a]	Rivalry (+)	3.61	1.13	**0.52**	0.37	0.10	0.01	**-0.41**	-0.03	0.41
qrv4	Feel that I must win at everything.[a]	Rivalry (+)	3.16	1.57	0.39	**0.41**	0.12	0.00	-0.30	-0.09	0.57
qsr1	Feel better with a loss when everyone else lost as well.	Soc.Regret (+)	4.05	1.22	-0.06	**0.58**	**0.44**	-0.02	-0.24	0.08	0.41
qsr2	Before I make a choice, I try to find out what other people choose.	Soc.Regret (+)	3.46	1.01	-0.24	0.35	0.25	0.20	0.15	-0.12	0.68
qsr3	Feel better when losing in a group than losing alone.	Soc.Regret (+)	4.09	1.27	-0.14	**0.44**	**0.47**	-0.06	-0.12	0.21	0.50
qsr4	Regret my mistakes less when others made the same choice.	Soc.Regret (+)	3.91	1.11	-0.06	**0.49**	0.38	-0.10	-0.13	0.10	0.58
qtm1	Understand how others think.[b]	ToM (+)	3.90	1.11	0.16	-0.17	**0.65**	-0.25	0.21	-0.29	0.34
qtm2	Able to explain others' behavior.[b]	ToM (+)	3.77	0.98	0.13	-0.21	**0.68**	-0.28	0.10	-0.29	0.30
qtm3	Feel I am not good at understanding others' behavior.[b]	ToM (-)	2.77	1.04	0.07	0.34	**-0.42**	0.18	0.19	0.36	0.50
qtm4	Feel confused about why people do what they do.	ToM (-)	3.61	1.21	0.36	0.36	0.04	0.36	0.20	0.08	0.56
qtr1	Trust in others doing the job well.	Trust (+)	3.54	1.00	-0.07	-0.23	**0.40**	-0.20	0.02	**0.42**	0.57
qtr2	Believe that others have good intentions.[c]	Trust (+)	4.04	0.96	-0.12	-0.31	0.29	-0.10	0.06	**0.47**	0.57
qtr3	Feel that others don't know what they are doing.[b]	Trust (-)	3.36	0.98	**0.52**	0.27	0.04	0.10	0.06	-0.08	0.63
qtr4	Doubt others' abilities or intentions.[b]	Trust (-)	3.23	0.94	**0.42**	**0.44**	-0.23	0.03	0.25	-0.28	0.44
qtr5	Suspect hidden motives in others.[c]	Trust (-)	3.45	1.08	0.36	**0.41**	0.11	0.18	0.16	-0.25	0.57

Table D.2: Trait questions and latent factors. Answer options (numerical values): "Always" (6), "Usually" (5), "Often" (4), "Sometimes" (3), "Seldom" (2), "Never" (1). Factor loadings ≥ 0.4 in bold. (N of subjects = 128.)

Sources: (a) Duffy and Kornienko (2010); (b) Duffy et al (2016); (c) Costa and McCrae (1992).

E Explaining Heterogeneity with Individual Characteristics

Here, we explore whether the self-reported individual characteristics (see Appendix D). can explain the individual heterogeneity in behavior.

We start with exploring individual patterns in information choice. To account for possible censoring, we conduct a Tobit regression analysis over the rates of choice of private information, at position $n \in P2, G2, G3, G4$ (see Table E.1).

$Private_{in}$	P2		G2		G3		G4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Private_{iP2}$				1.20***		0.19		0.32
				(0.26)		(0.29)		(0.34)
$Private_{iG2}$		0.98***				0.73***		0.13
		(0.17)				(0.25)		(0.40)
$Private_{iG3}$		0.22		0.69***				1.35***
		(0.18)		(0.19)				(0.29)
$Private_{iG4}$		0.37		-0.29		1.40***		
		(0.24)		(0.23)		(0.28)		
GP	0.18	0.21*	0.04	-0.02	-0.19	-0.11	-0.39	-0.29
	(0.14)	(0.12)	(0.17)	(0.13)	(0.17)	(0.15)	(0.27)	(0.24)
female	0.01	0.04	-0.02	-0.11	0.29	0.31	-0.26	-0.31
	(0.17)	(0.16)	(0.19)	(0.17)	(0.24)	(0.20)	(0.23)	(0.21)
age	0.00	-0.00	-0.00	-0.01	0.02	0.01	0.03	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
CRT_{MCQ}	0.30***	0.28***	0.11	-0.07	0.02	-0.00	-0.09	-0.10
	(0.08)	(0.08)	(0.07)	(0.05)	(0.08)	(0.07)	(0.12)	(0.10)
F1Contra	0.08	0.05	0.01	-0.08	0.14	0.09	0.12	0.08
	(0.08)	(0.06)	(0.09)	(0.07)	(0.10)	(0.09)	(0.11)	(0.11)
F2SocReg	-0.05	-0.02	-0.10	-0.07	0.10	0.06	0.10	0.04
	(0.08)	(0.07)	(0.08)	(0.06)	(0.10)	(0.10)	(0.13)	(0.12)
F3ToM	-0.07	-0.02	-0.09	-0.03	-0.04	-0.06	0.24*	0.31***
	(0.07)	(0.08)	(0.09)	(0.09)	(0.10)	(0.08)	(0.13)	(0.10)
F4Altru	-0.04	-0.02	-0.02	-0.04	0.00	0.01	0.01	0.04
	(0.07)	(0.06)	(0.11)	(0.08)	(0.09)	(0.08)	(0.13)	(0.11)
F5Aloof	-0.19**	-0.24**	0.03	0.10	0.12	0.10	0.01	-0.02
	(0.09)	(0.10)	(0.12)	(0.10)	(0.13)	(0.11)	(0.17)	(0.13)
F6Trust	0.02	-0.03	0.10	0.06	0.11	0.10	-0.11	-0.12
	(0.09)	(0.08)	(0.08)	(0.06)	(0.12)	(0.10)	(0.12)	(0.12)
_cons	0.48	-0.45	1.27***	0.56**	-0.28	-1.08***	-0.82	-1.38**
	(0.36)	(0.42)	(0.39)	(0.26)	(0.52)	(0.38)	(0.67)	(0.66)
F-test	2.63	13.56	0.69	4.88	1.09	7.12	1.63	3.21
p-value	0.01	0.00	0.73	0.00	0.38	0.00	0.11	0.00
Pseudo-R^2	0.13	0.31	0.03	0.28	0.03	0.18	0.07	0.26
No. Obs.	128.00	128.00	128.00	128.00	128.00	128.00	128.00	128.00

Table E.1: Tobit regressions on each subject's of private information rates in each position n, censored at 0 and 1. Robust standard errors (in brackets) clustered at the group level. (* p-value< 0.10, ** p-value< 0.05, *** p-value< 0.01).

Comparing the two regression specifications in Table E.1 for each position, choices of private information are strongly positively inter-correlated across some of the positions, suggesting "patterns" of subject behavior. But individual characteristics can hardly explain subjects' biases for or against private information. The exceptions are at position P2, where the (optimal) choice of private information is correlated with the cognitive proxy CRT_{MCQ}, and is negatively correlated with a lack of interest in social interactions, and at position G4, where subjects with higher "theory of mind" are marginally more likely to choose (empirically optimal) private information.

Finding 10. *Overall, with a few exceptions, there is not much effect of cognitive and non-cognitive measures on subjects' choice of private information.*

We also explore the information compliance rates, how often each subject i followed the information they chose to observe. As Table E.2 shows, the cognitive proxy CRT_{MCQ} is significantly positively correlated with the compliance rate for "All" (both private and social) information (specification 1). Yet this correlation is entirely attributable to subjects who rationally follow private information, since no traits explain subjects' compliance rates when they chose social information, as reflected by insignificant F–test for specification (5).

$Compliance_i$	All	P1+G1	P2+G2+G3+G4		
	(1) All	(2) Private	(3) All	(4) Private	(5) Social
GP	0.02	0.07	0.01	0.07	-0.03
	(0.03)	(0.05)	(0.03)	(0.07)	(0.04)
female	0.00	-0.05	0.01	-0.04	-0.02
	(0.04)	(0.07)	(0.04)	(0.11)	(0.05)
age	0.00	0.01	0.00	0.00	-0.00
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
CRT_{MCQ}	0.03***	0.05*	0.04***	0.11***	0.04*
	(0.01)	(0.03)	(0.01)	(0.04)	(0.02)
F1Contra	-0.01	-0.03	-0.00	-0.05	0.00
	(0.01)	(0.03)	(0.02)	(0.04)	(0.03)
F2SocReg	0.02*	0.02	0.03**	0.08**	0.00
	(0.01)	(0.03)	(0.01)	(0.04)	(0.02)
F3ToM	-0.03*	-0.07**	-0.02	-0.03	-0.02
	(0.02)	(0.03)	(0.02)	(0.04)	(0.04)
F4Altru	0.01	-0.03	0.01	0.02	0.01
	(0.01)	(0.03)	(0.01)	(0.04)	(0.03)
F5Aloof	-0.00	-0.04	-0.00	0.00	-0.02
	(0.02)	(0.03)	(0.02)	(0.05)	(0.02)
F6Trust	-0.00	0.01	-0.00	0.06	-0.02
	(0.02)	(0.03)	(0.02)	(0.05)	(0.03)
_cons	0.82***	0.85***	0.83***	1.00***	1.00***
	(0.06)	(0.16)	(0.06)	(0.16)	(0.09)
F-test	2.94	2.62	4.51	2.33	0.74
p-value	0.00	0.01	0.00	0.02	0.68
Pseudo-R^2	-0.95	0.17	1.75	0.14	0.08
No. Obs.	128.00	128.00	128.00	125.00	121.00

Table E.2: Tobit regression on each subject's compliance rates $Compliance_i$, censored at 0 and 1. Robust standard errors (in brackets) clustered at the group level. Last two specifications exclude subjects who never chose relevant information. (* $pvalue < 0.10$, ** $pvalue < 0.05$, *** $pvalue < 0.01$).

Finding 11. *Subjects with a higher proxy measure for cognitive ability (CRT_{MCQ} score) follow the information they choose to receive more frequently.*

We further conduct random-effects probit regressions (see Table E.3). Relatively to position P2, subjects favor private information at G2 (group effects); favor social information at G3 (tie neglect); and favor social information at G4 (triple neglect/PE) (see Table E.3, specifications (1)-(4)). Except at position G3, information compliance rate is similar across all 6 positions, and is strongly correlated with cognitive proxy CRT_{MCQ} (see Table E.3, specifications (5)-(8)).

	$Private_{i,t}$				$Follow_{i,t}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
P2					-0.06	-0.06	-0.06	
					(0.12)	(0.12)	(0.12)	
G1					0.00	0.00	0.00	
					(0.12)	(0.12)	(0.12)	
G2	0.54***	0.54***	0.54***		0.06	0.06	0.06	
	(0.14)	(0.14)	(0.14)		(0.12)	(0.12)	(0.12)	
G3	-1.19***	-1.19***	-1.19***		-0.38***	-0.39***	-0.39***	
	(0.16)	(0.16)	(0.16)		(0.14)	(0.14)	(0.14)	
G4	-2.37***	-2.37***	-2.37***		-0.03	-0.03	-0.03	
	(0.22)	(0.22)	(0.22)		(0.12)	(0.12)	(0.12)	
GP	-0.20	-0.13	-0.10	-0.07	-0.01	0.09	0.11	0.11
	(0.20)	(0.22)	(0.23)	(0.15)	(0.16)	(0.15)	(0.14)	(0.14)
time	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
female		-0.04	0.07	0.05		-0.02	-0.01	-0.00
		(0.20)	(0.21)	(0.13)		(0.16)	(0.19)	(0.19)
age		0.03	0.03	0.02		0.01	0.02	0.02
		(0.03)	(0.03)	(0.02)		(0.01)	(0.01)	(0.01)
CRT_{MCQ}		0.13	0.12	0.07		0.20***	0.19***	0.19***
		(0.10)	(0.10)	(0.06)		(0.06)	(0.06)	(0.06)
F1Contra			0.13	0.09			-0.04	-0.03
			(0.09)	(0.06)			(0.08)	(0.08)
F2SocReg			0.05	0.03			0.11**	0.11**
			(0.10)	(0.07)			(0.06)	(0.06)
F3ToM			0.01	-0.00			-0.12	-0.12
			(0.11)	(0.07)			(0.09)	(0.09)
F4Altru			-0.04	-0.03			0.03	0.03
			(0.12)	(0.08)			(0.07)	(0.07)
F5Aloof			0.04	0.04			-0.03	-0.03
			(0.15)	(0.10)			(0.09)	(0.09)
F6Trust			0.09	0.06			-0.00	-0.00
			(0.10)	(0.06)			(0.08)	(0.08)
_cons	0.91***	0.10	0.03	-0.44	1.70***	1.09***	1.02***	0.94**
	(0.16)	(0.72)	(0.78)	(0.53)	(0.15)	(0.37)	(0.38)	(0.37)
Wald χ^2	180.88	236.37	375.42	11.00	26.49	43.40	100.29	34.35
p-value	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00
No. Obs.	3072.00	3072.00	3072.00	3072.00	4608.00	4608.00	4608.00	4608.00

Table E.3: Random-effects probit regressions. (1)-(4): dummy variable $Private_{i,t}$ indicates whether subject i chose private information in round t at 24 relevant positions (baseline: P2 in PG ordering). (5)-(8): dummy variable $Follow_{i,t}$ indicates whether subject i followed either private signal, or subject in P1/G1, or majority in G4, in round t at all 36 positions (baseline: P1 in PG ordering). Robust standard errors (in brackets) clustered at the group level. (* $pvalue < 0.10$, ** $pvalue < 0.05$, *** $pvalue < 0.01$).